

Claims

Claim 1 to 28 (cancelled)

29. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:

- a first chamber having an inlet for a liquid; and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, and the second chamber comprises a upstream portion extending above the passageway and a downstream portion extending below the passageway; and

- a connecting structure having at least a first and a second conduits defined therein, wherein:

- the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and
 - the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.

30. A fluid distribution module according to claim 29, wherein the connecting structure further comprises a third conduit defined therein having a first end for connection to a post-dilution infusion tube and a second end connected to the first conduit.

31. A fluid distribution module according to claim 29, wherein the connecting structure further comprises a fourth and a fifth conduits defined therein, wherein

- the fourth conduit comprises a first end for connection to a blood withdrawal tube from a patient and a second end for connection to a first end of a pump hose of a peristaltic pump, and

- the fifth conduit comprises a first end for connection to a second end of the pump hose of a peristaltic pump and a second end for connection to a supply tube to a blood treatment device.

32. A fluid distribution module according to claim 31, wherein the connecting structure further comprises a sixth conduit defined therein having a first end for connection to an anti-coagulant tube and a second end connected to the fifth conduit.

33. A fluid distribution module according to claim 31, wherein the connecting structure further comprises a seventh conduit defined therein having a first end for connection to a pre-dilution infusion tube and a second end connected to the fourth conduit.

34. A fluid distribution module according to claim 29, wherein the connecting structure further comprises a first pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the first conduit, and the second compartment has a measuring port for connection to a gas pressure sensor.

35. A fluid distribution module according to claim 31, wherein the connecting structure further comprises a second pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the fourth conduit, and the second compartment has a measuring port for connection to a gas pressure sensor.

36. A fluid distribution module according claim 31, wherein the connecting structure further comprises a third pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the fifth conduit, and the second compartment has a measuring port for connection to a gas pressure sensor.

37. A fluid distribution module according to claim 31, wherein the connecting structure further comprises:

- a first pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the first conduit, and the second compartment has a measuring port for connection to a gas pressure sensor;
 - a second pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the fourth conduit, and the second compartment has a measuring port for connection to a gas pressure sensor; and
 - a third pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the fifth conduit, and the second compartment has a measuring port for connection to a gas pressure sensor,
- wherein the measuring ports of the first, second, and third pressure-measuring chambers have a central axis, and the central axes of at least two of the measuring ports are substantially parallel.

38. A fluid distribution module according to claim 31, wherein the connecting structure further comprises:

- a first pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the first conduit, and the second compartment has a measuring port for connection to a gas pressure sensor;
- a second pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the fourth conduit, and the second compartment has a measuring port for connection to a gas pressure sensor; and
- a third pressure-measuring chamber having a first and a second compartments separated by a flexible membrane, wherein the first compartment is connected to the fifth conduit, and the second compartment has a measuring port for connection to a gas pressure sensor,

wherein the central axes of the measuring ports of at least two of the first, second, and third pressure-measuring chambers are substantially perpendicular to a longitudinal axis of the degassing device.

39. A fluid distribution module according to claims 29, wherein the connecting structure has a periphery and comprises at least one socket connected thereto, wherein the socket has a recess for receiving one end of a tube and forms one end of one of the conduits defined within the connecting structure.

40. A fluid distribution module according to claim 39, wherein the connecting structure comprises a first and second sockets forming the second end of the fourth conduit and the first end of the fifth conduit, wherein the first and second sockets are so positioned that a pump hose having both ends received in the two sockets forms a loop that laterally extends within a plan from the connecting structure.

41. A fluid distribution module according to claim 29, wherein the first chamber of the degassing device has a downstream portion having a cross-section selected with respect to a maximal blood flow rate in an extracorporeal blood circuit connected to the degassing device so that the velocity of blood in the downstream portion of the first chamber is less than a predetermined velocity.

42. A fluid distribution module according to claim 41, wherein the cross-section of the downstream portion of the first chamber is selected with respect to a maximal blood flow rate in an extracorporeal blood circuit of about 500ml/min so that the velocity of blood in the downstream portion of the first chamber is less than about 3m/min.

43. A fluid distribution module according to claim 29, wherein the cross-section of the second chamber of the degassing device at the level of the passageway is selected so that the ratio of the velocity of blood within a downstream portion of the first chamber to the velocity of blood within the second chamber at the level of the passageway is more than a determined value.

44. A fluid distribution module according to claim 43, wherein the cross-section of the second chamber of the degassing device at the level of the passageway is selected so that the ratio of the velocity of blood within the downstream portion of the first chamber to the velocity of blood within the second chamber at the level of the passageway is at least about 2.
45. A fluid distribution module according to claim 29, wherein the downstream portion of the second chamber of the degassing device asymmetrically surrounds an upper part of the first chamber.
46. A fluid distribution module according to claim 45, wherein the first chamber comprises a downstream portion having a cylindrical wall extending along a longitudinal axis of the degassing device, and the downstream portion of the second chamber comprises a cylindrical wall partially surrounding the cylindrical wall of the first chamber and a bottom wall that is beveled with respect to the longitudinal axis of the degassing device.
47. A fluid distribution module according to claim 46, wherein the cylindrical wall of the first chamber and the cylindrical wall of the second chamber are concentric.
48. A fluid distribution module according to claim 29, wherein the passageway has a lesser cross-section than a cross-section of the second chamber so that a flow of liquid from the first chamber into the second chamber decreases within the second chamber.
49. A fluid distribution module according to claim 29, wherein the first chamber, the second chamber and the passageway are arranged with respect to each other so that a flow pattern of a liquid flowing through the degassing device comprises a component that is tangential to the hydrophobic membrane.
50. A fluid distribution module according to claim 29, wherein the flow pattern of a liquid flowing through the degassing device comprises an umbrella like component.

51. A fluid distribution module according to claim 29, wherein the first chamber, the second chamber and the passageway are arranged with respect to each other so that a liquid flowing through the degassing device keeps gas bubbles in motion along an inner surface of the hydrophobic membrane.

52. A fluid distribution module according to claim 29, wherein the first chamber comprises a downstream portion having a cross-section that is substantially the same as the cross-section of the passageway between the first and the second chambers.

53. A fluid distribution module according to claim 29, characterized in that the downstream portion of second chamber forms an overflow for a liquid flowing from the first chamber into the second chamber.

54. A fluid distribution module according to claim 29, wherein the upstream portion of the second chamber has a decreasing cross-section, with a larger cross-section that is substantially level with the passageway and a smaller cross-section that is substantially level with the hydrophobic membrane.

55. A fluid distribution module according to claim 29, wherein the outlet opens in the second chamber at a lowest point thereof.

56. An extracorporeal blood circuit comprising:

- a fluid distribution module according to one of the claims 31 to 55;
- a pump hose having a first end connected to the second end of the fourth conduit and a second end connected to the a first end of the fifth conduit;
- a blood withdrawal tube connected to a first end of the fourth conduit;
- a supply tube to a blood treatment device connected to the second end of the fifth conduit;
- a discharge tube from a treatment device connected to the first end of the first conduit; and
- a blood return tube connected to the second end of the second conduit.

57. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:

- a first chamber having an inlet for a liquid; and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, and the second chamber comprises an upstream portion extending above the passageway and a downstream portion extending below the passageway, and

- a connecting structure having at least a first, second, fourth and fifth conduits defined therein, wherein:

- the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device,
 - the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient,
 - the fourth conduit comprises a first end for connection to a blood withdrawal tube from a patient and a second end for connection to a first end of a pump hose of a peristaltic pump, and
 - the fifth conduit comprises a first end for connection to a second end of the pump hose of a peristaltic pump and a second end for connection to a supply tube to a blood treatment device,

wherein the second end of the fourth conduit and the first end of the fifth conduit are so positioned that a pump hose connected thereto forms a loop that laterally extends within a plan from the connecting structure.

58. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:

- a first chamber having an inlet for a liquid; and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
- wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, and the first chamber has a downstream portion having a cross-section selected with respect to a maximal blood flow rate in an extracorporeal blood circuit connected to the degassing device so that a velocity of blood in the downstream portion of the first chamber is less than a predetermined velocity; and
- a connecting structure having at least a first and a second conduits defined therein, wherein:
 - the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and
 - the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.

59. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:
 - a first chamber having an inlet for a liquid; and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, and the cross-section of the second chamber of the degassing device at the level of the passageway is selected so that the ratio of a velocity of blood within a downstream portion of the first chamber to a velocity of blood within the second chamber at the level of the passageway is more than a determined value; and
- a connecting structure having at least a first and a second conduits defined therein, wherein:

- the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and
- the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.

60. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:
 - a first chamber having an inlet for a liquid; and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
 wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, the second chamber comprises a upstream portion extending above the passageway and a downstream portion extending below the passageway, and the downstream portion of the second chamber of the degassing device asymmetrically surrounds an upper part of the first chamber; and
- a connecting structure having at least a first and a second conduits defined therein, wherein:
 - the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and
 - the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.

61. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:
 - a first chamber having an inlet for a liquid; and

- a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway that has a lesser cross-section than a cross-section of the second chamber so that a flow of liquid from the first chamber into the second chamber decreases within the second chamber; and
- a connecting structure having at least a first and a second conduits defined therein, wherein:
 - the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and
 - the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.

62. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:
 - a first chamber having an inlet for a liquid; and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, and the first chamber, the second chamber and the passageway are arranged with respect to each other so that a flow pattern of a liquid flowing through the degassing device comprises a component that is tangential to the hydrophobic membrane; and
- a connecting structure having at least a first and a second conduits defined therein, wherein:
 - the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and

- the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.

63. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:

- a first chamber having an inlet for a liquid; and
- a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, and the first chamber, the second chamber and the passageway are arranged with respect to each other so that a liquid flowing through the degassing device keeps gas bubbles in motion along an inner surface of the hydrophobic membrane; and

- a connecting structure having at least a first and a second conduits defined therein, wherein:

- the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and
- the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.

64. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:

- a first chamber having an inlet for a liquid; and
- a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, the second chamber comprises a

upstream portion extending above the passageway and a downstream portion extending below the passageway, and the downstream portion of second chamber forms an overflow for a liquid flowing from the first chamber into the second chamber; and

- a connecting structure having at least a first and a second conduits defined therein, wherein:
 - the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and
 - the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.

65. A fluid distribution module for causing and monitoring the circulation of fluids from and to a patient through an extracorporeal blood treatment device, comprising:

- a degassing device comprising:
 - a first chamber having an inlet for a liquid; and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber partially extends within the second chamber and communicates therewith by an upper passageway, the second chamber comprises a upstream portion extending above the passageway and a downstream portion extending below the passageway, and the upstream portion of the second chamber has a decreasing cross-section, with a larger cross-section that is substantially level with the passageway and a smaller cross-section that is substantially level with the hydrophobic membrane; and
- a connecting structure having at least a first and a second conduits defined therein, wherein:
 - the first conduit comprises a first end for connection to a discharge tube from the treatment device and a second end connected to the inlet of the first chamber of the degassing device, and
 - the second conduit comprises a first end connected to the outlet of the second chamber of the degassing device and a second end for connection to a blood return tube to a patient.